A

OLUME TWELVE

NUMBER THREE

Spandrel panels ver the dining oom windows were ormed with wood olds. Roof over he waiting room is sed for outdoor ining and observa- ion decks.

(Front Cover) The entrance to the Long Beach Municipal Airport Administration Building is protected by a long marquee. Kenneth S. Wing was associated with W. Horace Austin (deceased) as architect for the project.

The activities of the Portland Cement Association, a national organization, are limited to scientific research, the development of new or improved products and methods, te service, promotion and educational effort (including safety work), and are primarily designed to improve and extend the uses of portland cement and concrete. The manifold pr of the Association and its varied services to cement users are made possible by the financial support of over 60 member companies in the United States and Canada, enga the manufacture and sale of a very large proportion of all portland cement used in these two countries. A current list of member companies will be furnished on r

COPYRIGHT, 1947 BY PORTLAND CEMENT ASSOCIATION

Architectural
CONCRETE

ublished by PORTLAND CEMENT ASSOCIATION • 33 West Grand Avenue, Chicago 10, Illinois

Airport Administration Building
—Long Beach, Calif.

By Kenneth S. Wing*, AIA

A major requirement in designing the administration building at the Municipal Airport in Long Beach, alif., was to provide a building that would adequately ndle present traffic and at the same time lend itself to nsiderable expansion. The building is 175 ft. long and ½ ft. wide with two stories and basement over the tire area and third and fourth stories over part of the ea. It is slightly curved in plan, like a small segment of a agon wheel, the hub of which is at the intersection of the 0-ft. access road and Lakewood Blvd., the main route to e city. The building can be extended on either end to m a semicircle abutting the boulevard.

Whether approaching the building from the highway or om the field, the visitor is impressed with the neatness and e atmosphere of efficient administration. The approach, rough a large parking area, ends in a wide curving drive-ay on which the entrance facade faces. One steps directly om automobile, taxi or bus onto a covered terrace. Three trance doors are set in the wall which is recessed 8 ft. ck of the end wings and a long concrete marquee extends out another 4 ft. This gives a covered area 12 ft. wide and 97 ft. long, large enough to handle the heavy traffic without congestion. The canopy has been extended past the end wings and is carried around the corners of the building.

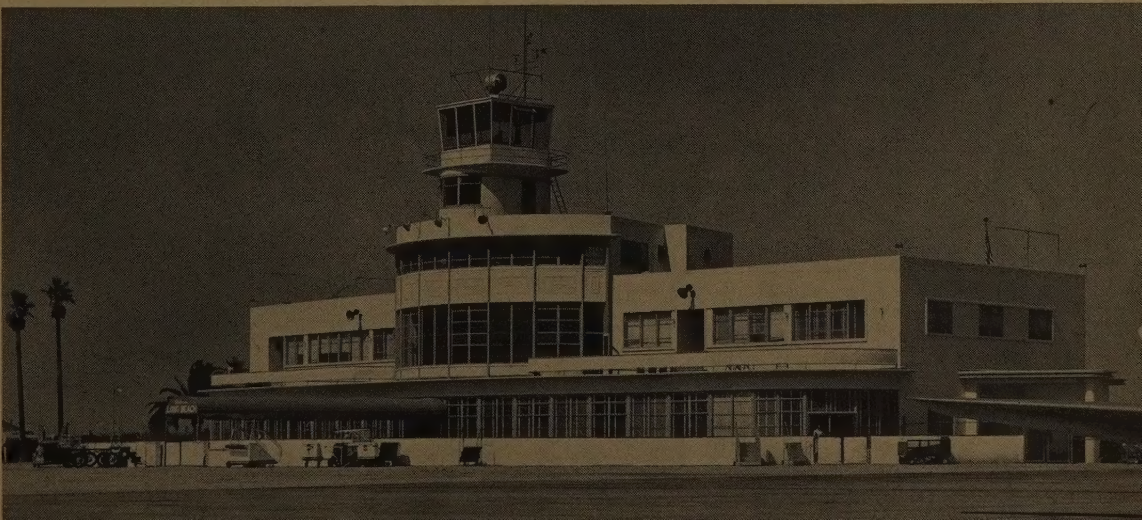
All exterior walls are reinforced concrete with an interesting texture produced by using ship-lap lumber for the contact surfaces of the forms. Concrete surfaces were finished with two coats of portland cement paint in light terra cotta. Base and trim are in a deeper shade of terra cotta. The light color of the walls forms an excellent background for the lettering over the entrance.

On the field side of the building a 16-ft. deep waiting room projects beyond the main structure and across the entire length of the building. The outer wall is a continuous line of windows. In the center of the second floor is a deep bay 54½ ft. across with tall windows forming the outer wall of the dining room and flooding the room with light. To provide good views of the field from all tables, the floor of the dining room is built on three levels. The roof

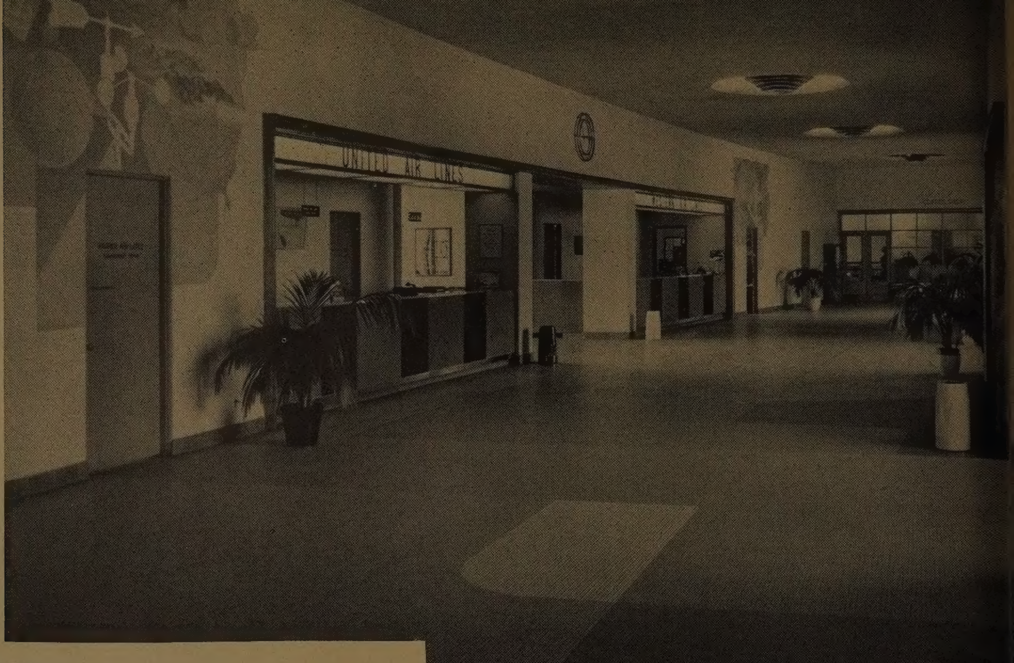
---

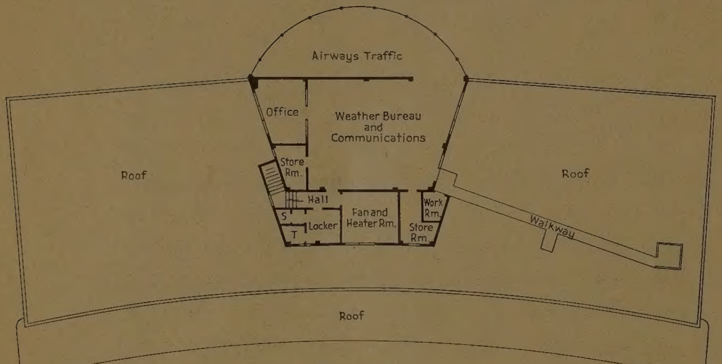
*Long Beach, Calif.

he large area of ass toward the ld side is a fea- e of the building. all windows in e dining room rmit good views the field for all trons.

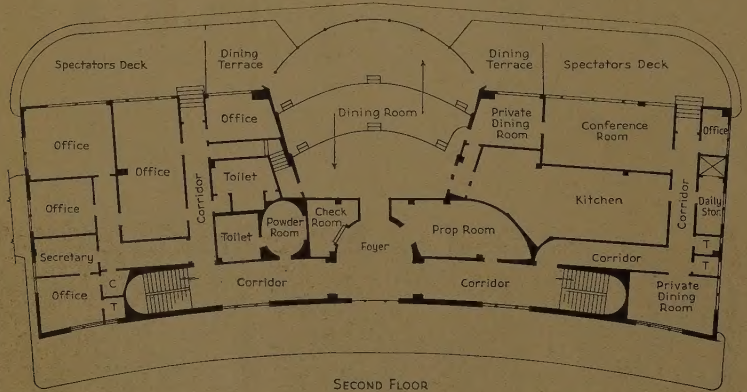


The concourse floor is finished in ceramic tile, a decorative feature of which is a developed globe showing world air routes.

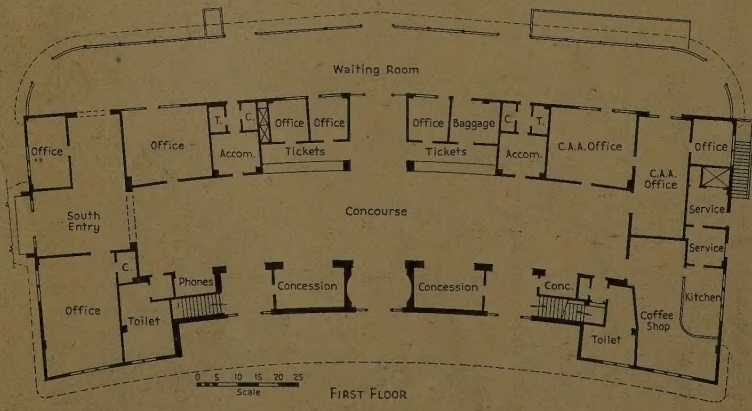




THIRD FLOOR



SECOND FLOOR



FIRST FLOOR

over the waiting room on either side of the dining room bay is used as dining terraces and spectator decks. The second floor bay continues through the third floor, where it is used for the weather and communications bureau and airways traffic department. Above this is the control tower.

Spandrel panels over the restaurant section have decorative features cast in the concrete and formed by wood molds. Window groupings on the second floor are framed by projecting moldings. Reinforced concrete was used for structural frame, floors and roof. In general, partitions are wood studs with plaster. Exterior walls are plastered directly. This procedure, satisfactory in this relatively mild climate, is inadvisable in colder climates, where the plaster should be furred out. Inside walls are painted with oil paint. In all public areas the ceilings have acoustical plaster.

Entrance from the street side is directly into a wide concourse running the length of the building with ticket offices and concessions on either side. The concourse floor is covered with mosaic tile in several colors with a number of decorative features, such as a developed globe at the central axis on which world air routes are shown. At one end of the concourse is a coffee shop. Combination air diffusers and light fixtures form a decorative ceiling treatment.

Besides the large dining room, the second floor has circular foyer, two private dining rooms, large kitchen, conference room, a number of offices, powder room and toilets.

The writer was associated with W. Horace Austin (deceased) as architects for the project. J. H. Davies and R. D. Van Alstine were associated structural engineers and Stanton-Reed Co., Los Angeles, was the contractor.

ire Safety and Economy

Main Requirements for Bardstown, Ky., School

By R. V. Sparrow*

NELSON County, Ky., is rich in history but there is nothing antiquated about its public school system. Ample dence of its progressive attitude toward education is the w Nelson County consolidated school at Bardstown, miles from Abraham Lincoln's birthplace and in sight the house which inspired Stephen Foster to write "My d Kentucky Home".

The school was completed in April, 1945, at a cost of 00,000 to replace a score of outmoded one-room rural ools. It is located on an 11-acre tract of land which proles spacious grounds for all types of outdoor sports.

In selecting the type of building material for the school, esafety was the first consideration and economy of conuction was the second. Architectural concrete was chosen cause it combines both features with strength and beauty.

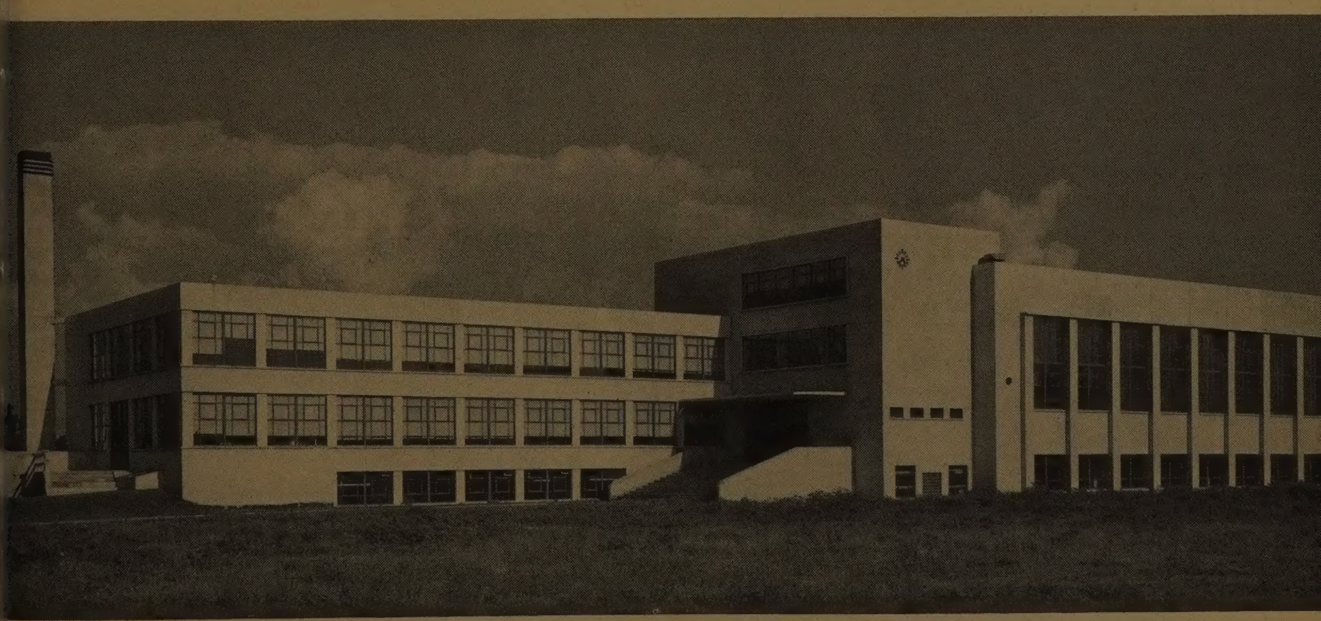
The exterior concrete walls were formed to produce ooth surfaces which were left as they came from the forms cept for a cleandown. Interior partitions are lightweight ncrete masonry units, exposed and painted. The floors e concrete slabs covered with asphalt tile, except in the mnasium, where the finish floor is wood.

Each of the three divisions of the building—the school proper, the combination gymnasium and auditorium, and the offices of the county school board—is provided with a separate entrance. This plan keeps the school children separate from any group that might be using the auditorium and makes it unnecessary for people to pass through the school corridors when calling to do business with the school board. The board offices occupy the first floor front of the building; the gymnasium is in the west rear section; and the school proper takes up the remainder of the building.

The building contains a full basement, two stories and a music room penthouse. This location of the music room in the penthouse eliminates all possibility of disturbing pupils in classrooms and permits practice at any time school is in session. An attractive art room with plenty of light is directly below the music room. The 14 classrooms are identical and have enormous window space which makes natural light adequate except on the darkest days. Each room is connected with a communication system originating in the principal's office.

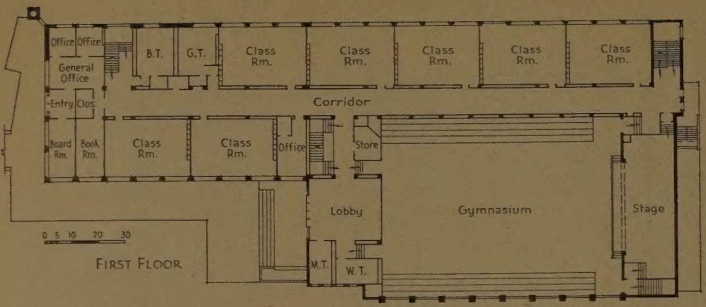
Cafeteria, kitchen and separate playrooms for boys and girls are located in the basement. The cafeteria was de-

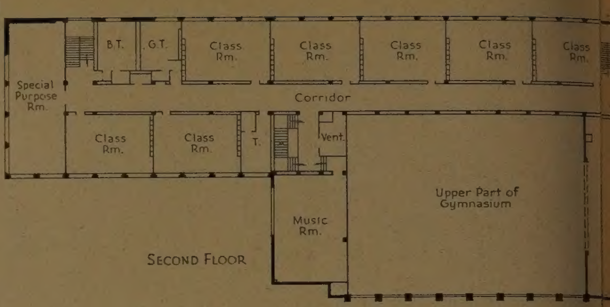
mplicity keynotes the design of the high school in Bardstown, Ky. W. Earle Otis, architect of Louisville, designed the building, which was pervised by Gaarwood M. Grimes, another Louisville architect.



---

ounty School Superintendent, Nelson County, Ky.





signed so that it can be partitioned off into two additional classrooms if needed and still have sufficient space for feeding the children.

Because of its firesafe construction, insurance rates on the school are 15 cents per $100 compared with 40 cents on the frame and brick Bardstown High School.

Lt. Col. C. W. Hart, now in the U.S. Army, was county school superintendent when the building was started. W. Earle Otis, Louisville architect, designed the building and supervised construction until he was called to military service. The job was completed under the supervision of Gaarwood M. Grimes, another Louisville architect.

Junior College—Paris, Texas

By Will H. Lightfoot, Architect*

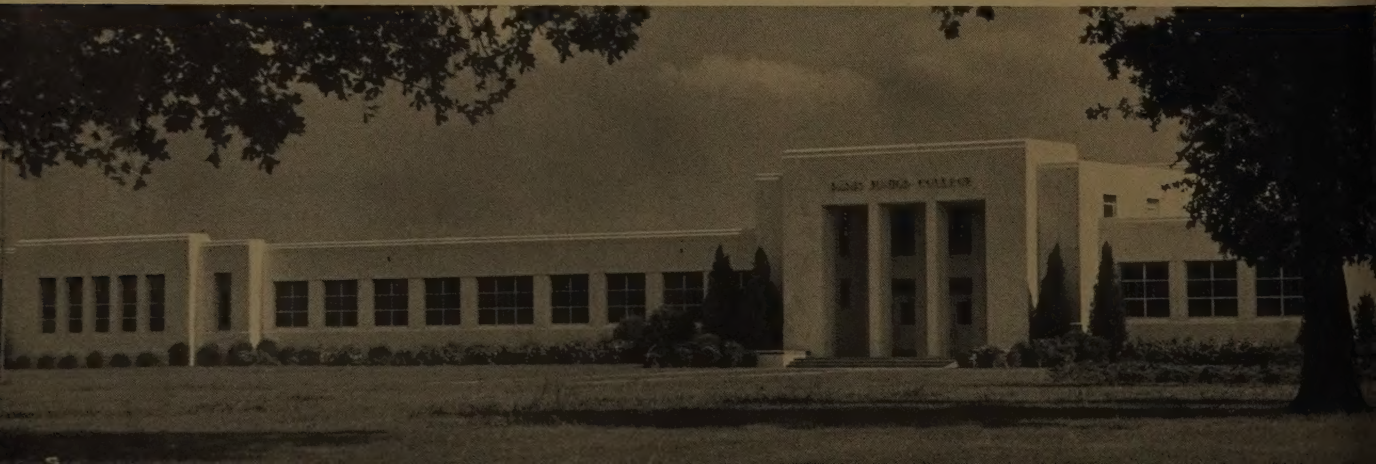
Founded in 1924 to provide advanced educational opportunities for Paris and northeast Texas, the Paris Junior College grew swiftly. By 1939 the school had received such widespread acceptance that students were overflowing the quarters originally provided. It was obvious that these quarters were inadequate—that something had to be done to provide additional space and facilities for this rapidly growing institution.

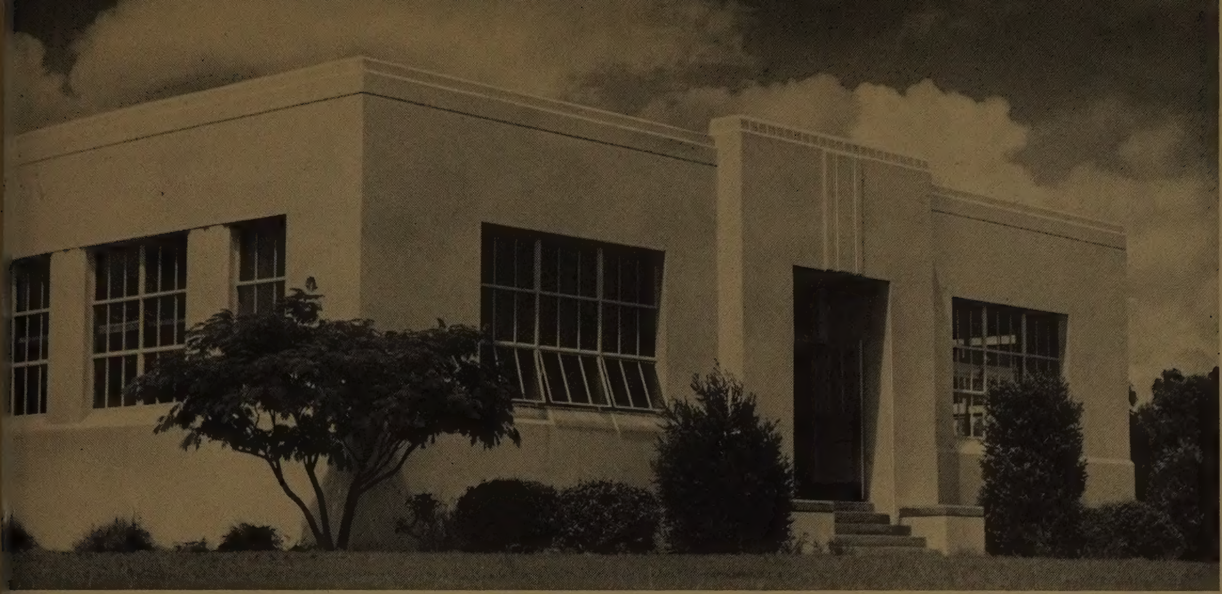
Faced with this situation, President J. R. McLemore, with the support of an alert board of trustees and an unusually large group of civic-minded citizens, began a campaign which resulted in the approval of a $200,000 bond issue. A 38-acre site was acquired adjacent to the eastern boundary of Paris and a three-year construction program

---

*Paris, Tex.

The main classroom building of Paris Junior College is a striking example of functional architecture which achieves pleasing appearance through simplicity of line and well-handled masses. Will H. Lightfoot was the architect and R. L. Rolfe of Dallas was the structural engineer for all structures at the college. Phelps and Dewees and Simmons of San Antonio were consulting architects on the main building.



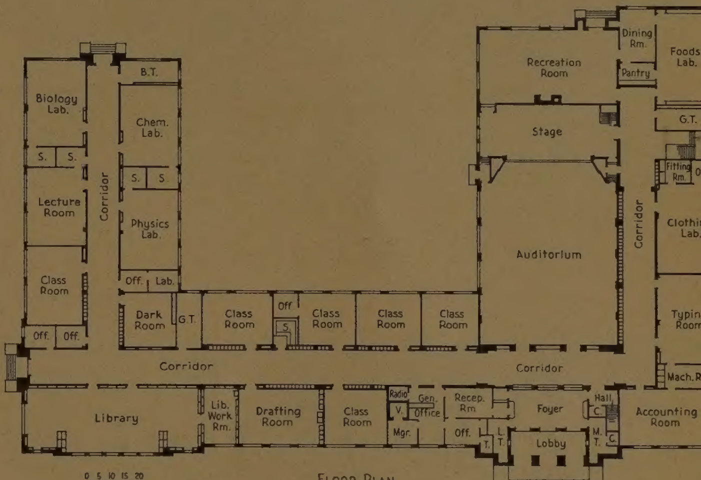


he entire design is characterized by simple detail, as shown by s end view of one wing of the main building.

as adopted. Included in this program were a main class-om building, a gymnasium and a stadium of 4,800 pacity.

The building of these structures was accomplished with deral government participation. Even with such help the nds available required the utmost economy to avoid crificing appearance, anticipated life, fire safety or low aintenance. Architectural concrete was selected because met these requirements. Now after the structures have en in use for more than six years—certainly time to aluate this choice—we feel that the results are even better an had been anticipated. The original paint used as the al finish is still in sound condition, free of scaling or stains. ontrol joints placed at the center of each opening have erated effectively to prevent cracking.

The main classroom building has one story and a base-ent. Ten classrooms, 10 offices, 11 laboratories, an audi-rium, a library and music studios are on the main floor; cafeteria and storage rooms are in the basement. All walls e reinforced concrete, 12 in. thick below the sills, 10 in. ick above, with two curtains of 3/8-in. rd. reinforcing ars, 8 in. on centers horizontally and 12 in. on centers rtically. The exterior form face was made up of 3/4-in. ywood; 1x8 ship lap was used for the interior face. Con-ete was placed in four lifts: the first lift to the sill line, e second to the heads of the windows, the third to the ottom of the roof joists and the fourth to the top of the arapet. Exterior wall surfaces were rubbed with rotating rborundum wheels and then painted with two coats of l base paint. Inside surfaces were finished with ½ in. of ement plaster applied directly to the concrete walls. This actice is practical in some locations where it is relatively arm and dry but in most areas the plaster is generally furred out or other forms of insulation provided to prevent condensation.



FLOOR PLAN

Walls of the gymnasium building are of construction similar to those of the classroom building, except that some are 12 in. thick for their full height. Bleachers along one side of the gymnasium floor are of concrete construction.

Both buildings are striking examples of functional architecture. Almost devoid of decorative features, they depend on mass, fenestration and a few offsets in the walls for effectiveness. A rustication below the top of the wall and an offset in the parapet emphasize the long roof lines. The main entrance is distinguished by two large rectangular columns two stories in height which form a three-opening portico. The reveals of the openings have shallow offsets creating vertical lines which increase the apparent height of the entrance. Side entrances have a simple projecting panel over the doorway. V-incised vertical lines are introduced into the offset coping of the parapets over the en-

Construction of the architectural concrete gymnasium is similar to that of the main building.

One of twin concrete grandstands, which seat a total of 4,800 spectators.

trances. All these simple decorative touches were produced with ordinary wood forms.

The stadium consists of two reinforced concrete stands of similar design and size on opposite sides of the playing field. A two-story pressbox and broadcasting station is provided at the center of one stand. The concrete walls of these structures are 8 in. thick and are finished similarly to those of the other building.

Shotcrete* Cuts Building Cost

Reductions in form lumber up to 75 per cent, lowered labor cost and savings in cost of concrete building walls of 20 per cent or more are reported by several California contractors. These economies have been realized by "shooting" the concrete into place with a "gun" instead of the more usual method of casting it. Generally referred to as "shotcrete", this method of construction is not new but

Towne Theater, Long Beach, Calif., has 6-in. thick shotcrete walls over 40 ft. high. Plywood forms were used on the front and boards on the sides and back. Dark portions were painted with dark gray portland cement paint, light portions with white portland cement paint. Shotcrete contractor, Johnson Western Co. of Los Angeles, (San Pedro).

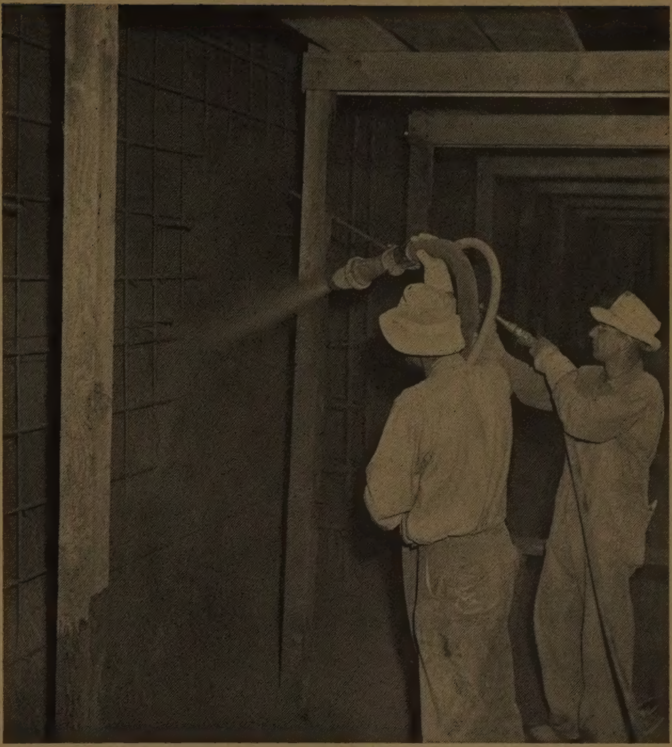
---

*General term for pneumatically applied concrete, including Gunite which is applied with the Cement Gun. All jobs described in this article were done with Cement Gun equipment.

has been used chiefly for repair, reconstruction and nilar purposes. Its use in new construction, especially for alls, had been rather limited. With lumber on the critically arce list and with skilled labor almost equally scarce, the ssibilities of shotcrete were studied by some West Coast ntractors specializing in shotcrete work. As a result, sev- al dozen buildings of various sizes and occupancies have en constructed during the past year by this method in s Angeles, Long Beach and San Diego. While the ad- ntages are more pronounced during a period of shortages, vocates of this construction claim that even under normal nditions there will be appreciable savings.

Instead of an inside form and an outside form as required r cast-in-place walls, only a single form is necessary for otcrete walls. This single form may be for either the out- le or inside surface of the wall. In most cases it has been r the outside wall surface and decorative features have en included. These have required the incorporation of th wood moldings and plaster waste molds in the form. he form is erected on top of footings of cast-in-place con- ete. These footings have projecting steel dowels to which e wall reinforcement is tied. After the single face form is position, the reinforcement is placed; then the concrete shot from the inside against the form. Guide wires are etched to indicate the thickness of wall and the inside rface is simply screeded off against the wires. In some stances an inside face form has been used and the exterior rface of the concrete given a special finish. A favorite nish is obtained by floating with a wood float to which is mented a square-edged sheet of sponge rubber about in. thick.

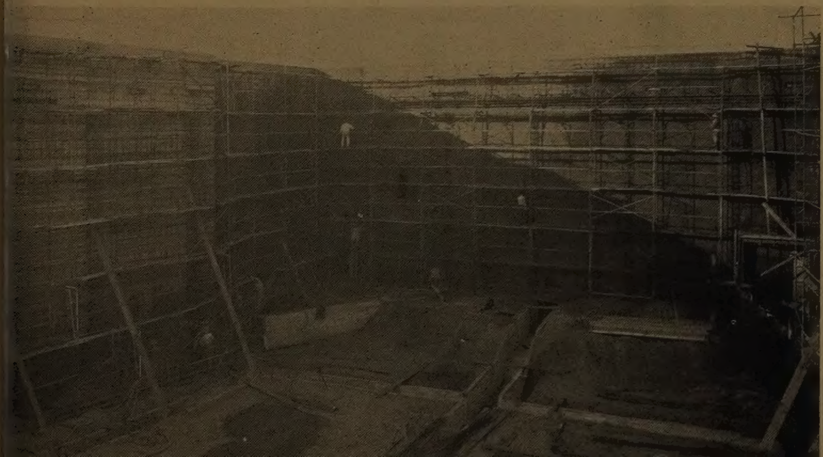
Using only one face form instead of two means an ppreciable saving in lumber and carpenter labor. Addi- onal savings are made, however, because the form can be ghter and requires less bracing since no hydrostatic pres- re on the forms is developed as in the case of cast-in-place ncrete. Thus where the average form, consisting of an in- le and an outside face form, requires 5 to 6 bd.ft. of lumber



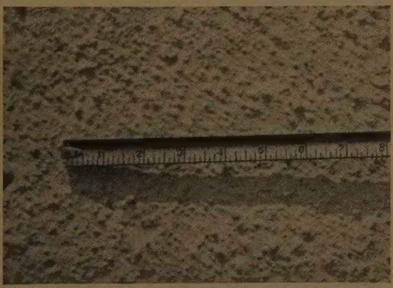
Shooting concrete into the wall. Workman at right of nozzleman is using an air jet to remove accumulated rebound from form and reinforcement.

Portable shooting equipment of the Johnson Western Co., formerly the Case Construction Co., consists of mixer and gun mounted on a trailer and air compressor on a truck.

terior view of Towne Theater shows single form completed the full height of the wall d reinforcing in position. Shotcrete has already been applied to part of the rear wall. fter the shotcrete work is completed the scaffold is left in place for other building trades.



Texture produced by screeding shotcrete to finish line and then "flashing" final gun coat over the surface. Shotcrete contractor, Johnson Western Co.



Boyle Hardware Building, Compton, Calif. The molded detail associated with cast-in-place architectural concrete can be executed equally well by placing the concrete pneumatically with shotcrete equipment. Shotcrete contractor, Los Angeles Cement Gun Co.

for each square foot of wall, the single form for shotcrete requires only 1½ to 2 bd. ft. This represents a saving of 70 to 75 per cent in lumber. When 1-in. boards are used for the form face the studs are placed on 28-in. centers; where plywood is used the studs are on 30- to 36-in. centers. This is in contrast to the usual 16-in. stud spacing for 1-in. boards and heavy plywood sheathing, or the 12-in. spacing for lighter plywood ordinarily used for cast-in-place work.

Only a few light wales are required. In one-story construction usually single 2x4 wales are placed at the bottom of the form, halfway up and at the top. The form is usually braced by sloping 2x4's. Ordinarily, for cast-in-place architectural concrete walls, double 2x4 wales are used at 24-in. centers, and for high lifts heavier vertical wales are used outside of these. From this it is seen that the saving in lumber for this purpose is appreciable. In addition, no tie rods are required for the shotcrete walls. Consequently, there is no filling or patching of holes left by ties. Forms must be made sufficiently rigid, of course, to insure straight, plumb walls.

When pilasters are to be incorporated with the wall, side pieces are set to form the additional thickness. Similarly, at spandrel beams, a soffit form is set to provide for the additional thickness. Chamfer strips are provided where necessary. Guide wires are stretched at the upper corners of the beam and the concrete is screeded to these wires.

Scaffolding is required to provide a working platform for applying the shotcrete but since scaffolds are often required for erecting forms and placing concrete in cast-in-place walls as well as for use of other trades it is not considered an expense unique to this type of construction.

The reinforcing steel corresponds to that used for cast-in-place work. On most of the work 6-in. walls have been used with a single curtain of steel. Two curtains of steel are used for 8-in. walls. The steel is supported from the single form but it is important that it be held rigidly in position. Pilaster and spandrel beam reinforcement is placed at the same time as the wall steel.

The shotcrete mixture used for these walls has consisted of 1 part portland cement to 4½ parts of sand by volume. Cement and sand are mixed dry and then placed in the gun hopper. The shotcrete is placed by compressed air at a pressure of 30 p.s.i. or more. Water is added at the nozzle and must be supplied at a pressure at least 15 lb. above air pressure and not less than 60 p.s.i. Tests of cylinders built up by shotcrete in standard 6x12-in. molds have

Oral Surgery Building, Long Beach, Calif. This close-up view shows the excellent quality of surface, sharp-edged rustication and canopy detail which can be produced by the shotcrete method of construction. Shotcrete contractor, California Gunite Co.

ımman, Avery and Kenneth
Wing Building, Long
ach, Calif. Concrete for
alls was shot against ply-
od forms except in spandrel
rear of court. Here corru-
ted iron was used to form
fluted surface of the shot-
te. The California Gunite
. of Long Beach was the
tcrete contractor.

aron Schultz Furniture Store, Long Beach, Calif. The fluted
lumns and decoration over door were produced with plaster waste
lds. Beveled siding effect was produced by use of overlapping ply-
od strips. Wood blocks were nailed to the plywood to form the
rizontal band below the parapet. Shotcrete contractor, Johnson
estern Co.

eraged over 5,500 p.s.i. at 28 days, and cores cut from
e wall have averaged 5,000 p.s.i. when corrected for size
fferential.

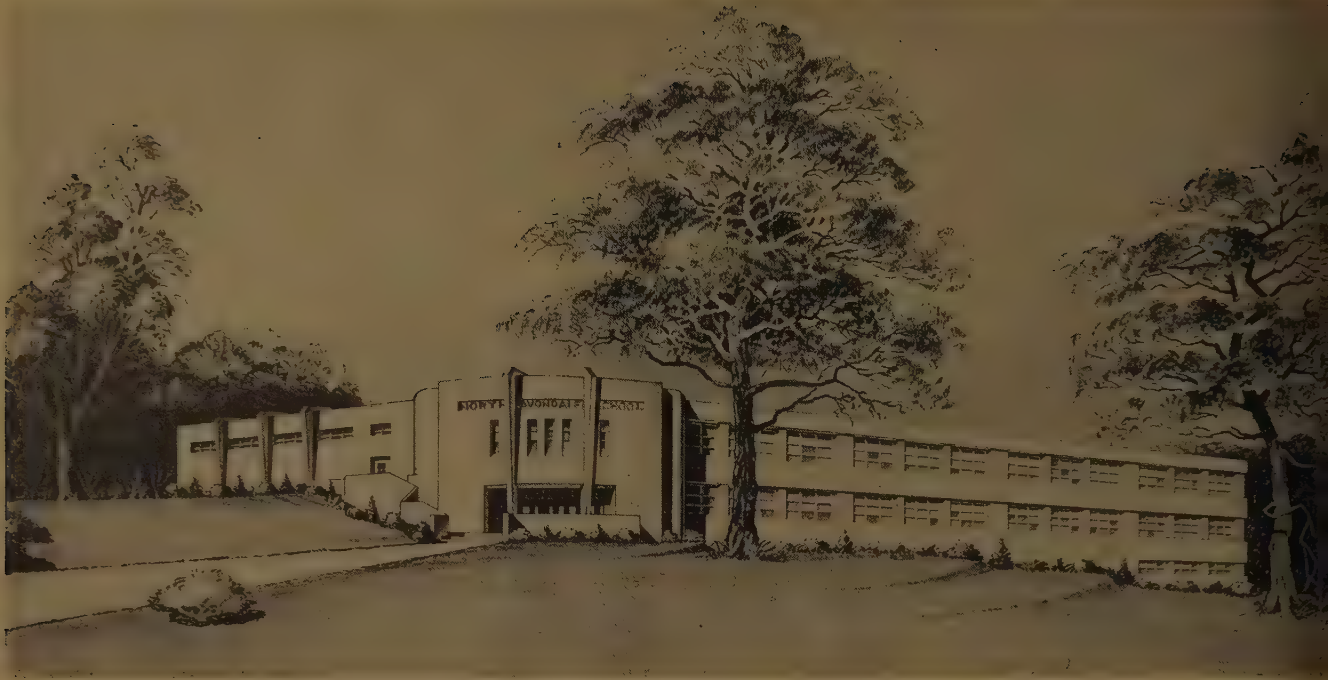
For 6-in. walls the shotcrete is applied in two layers and
r thicker walls three or more layers are used. Each layer
broomed to assist bond between layers. The nozzle is
ld at right angles to the form surface and at a distance
3 to 5 ft. The first layer is shot against the form and
ought out to the outside edge of the reinforcing steel.
air jet is used to blow off accumulated rebound from
e reinforcing steel and from the form. When enclosing
e steel, the nozzle is held at an angle to direct the material
hind the bars, first from one direction and then from the
her, so as to embed the steel thoroughly. In 6-in. walls
e second application is brought out to the full wall thick-
ss. When built up to the required thickness, the surface
screeded with a 4-ft. steel straightedge along the guide wires to give a perfectly straight wall. Pilasters and spandrel beams are shot to the required thickness and screeded off to the forms.

The usual placing procedure is to shoot from floor line to the top of the wall. Vertical control joints are constructed at suitable locations and metal V-strips are provided in the joints by attaching them to the form. These joints are natural stopping places in the shooting procedure. After the wall is completed the form is left in place a few days before stripping, care being taken to prevent rapid drying of the concrete. Exterior wall surfaces are painted with cement paint after all construction has been completed.

In the Towne Theater Building at Long Beach, interior columns and beams and the mezzanine floor as well as the walls were constructed of shotcrete. For interior columns, forms were erected on three sides and interior beams were formed on the soffit and one side. The concrete was shot into the columns in vertical layers about 3 in. thick, each layer extending from floor line to top of column. The mezzanine floor slab is 4 in. thick, built up in two layers and reinforced with small diameter bars.

On these West Coast buildings the rate of placing shotcrete has been about 15 to 20 cu.yd. per day. On a building of average size, requiring 100 cu.yd. or so of concrete, the walls are completed in a little more than two weeks. The walls of the Towne Theater are 40 ft. high and were built complete in 60 days. Over 1,100 cu.yd. of shotcrete was used. Forms were 1x6-in. sheathing on 2x4-in. studs at 24-in. centers except for the front wall, where ⅝-in. plywood on 2x4-in. studs on 30-in. centers was used. Walls are reinforced with a single curtain of ½-in. bars at 12-in. centers each way.

Shotcrete is somewhat more expensive to place than cast-in-place concrete. This absorbs some of the savings made in form material and labor. But in many cases the net saving in cost has been reported to be 20 per cent or more of the cost of the wall construction where a 6-in. shotcrete wall is compared with an 8-in. cast-in-place wall.

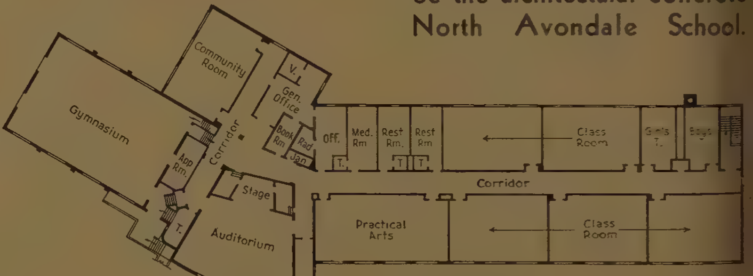


NORTH AVONDALE SCHOOL

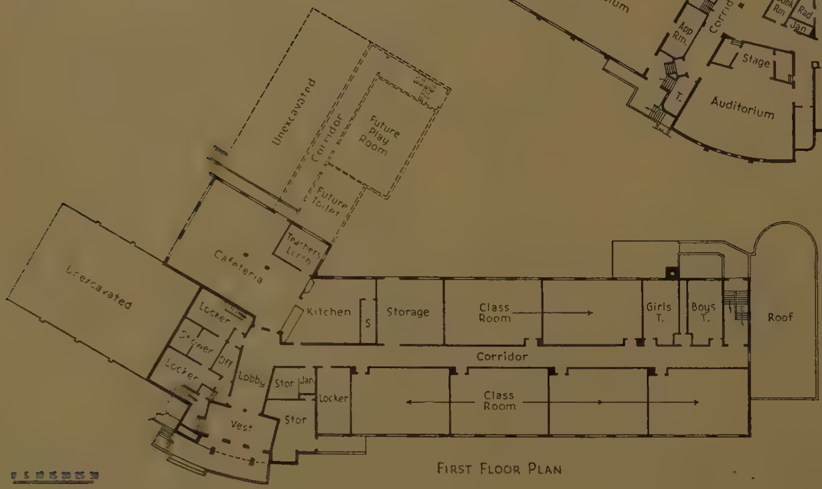
Cincinnati, Ohio

E. C. and G. T. LANDBERG, architects

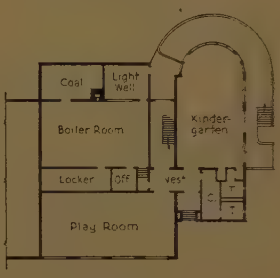
The Cincinnati Board of Education in 1943 authorized a school building survey to determine what should be done with old facilities and how many new buildings would be necessary to meet the needs of the community. The survey recommended a construction program including 31 new buildings. The first of these buildings to be erected will be the architectural concrete North Avondale School.



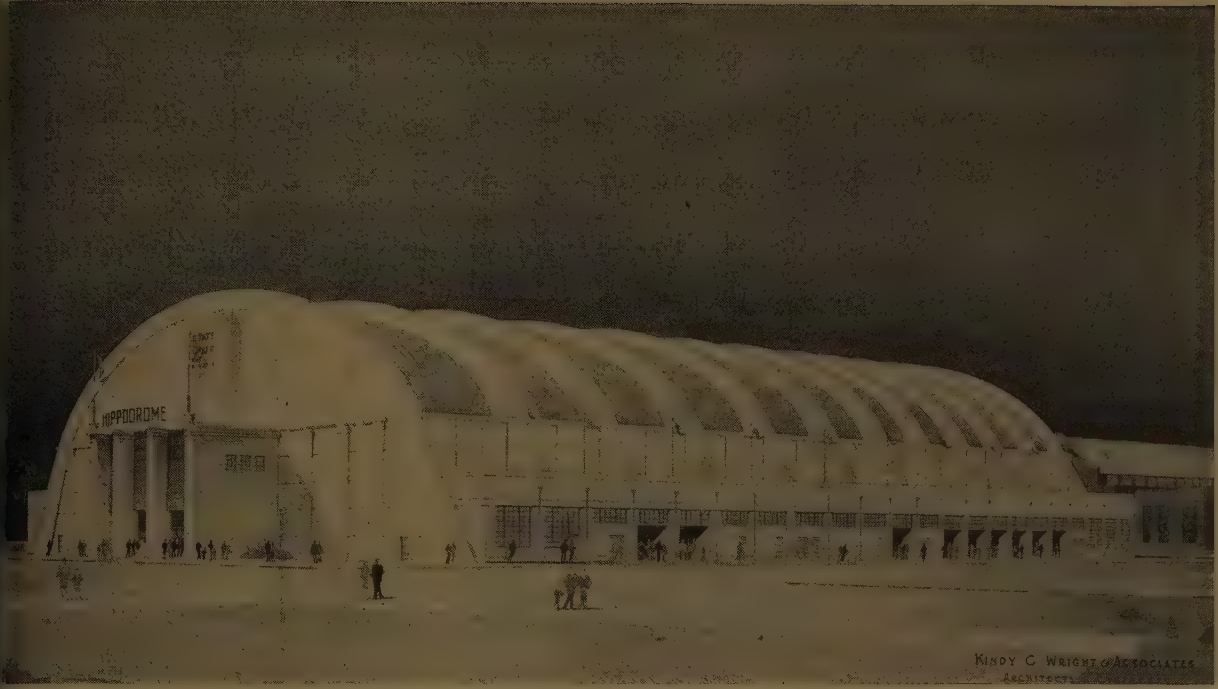
SECOND FLOOR PLAN



FIRST FLOOR PLAN



BASEMENT PLAN



hen the Army turned back the 40-year-old Hippodrome
the Minnesota State Fair Grounds, after using it for nearly
ree years as a manufacturing plant for airplane propellers,
was found that reconversion of the building to the purposes
the Fair would cost almost as much as complete replace-
ent. The progressive management of the Fair accordingly
ecided to construct on the same site a modern building to
place the old one.

HIPPODROME BUILDING

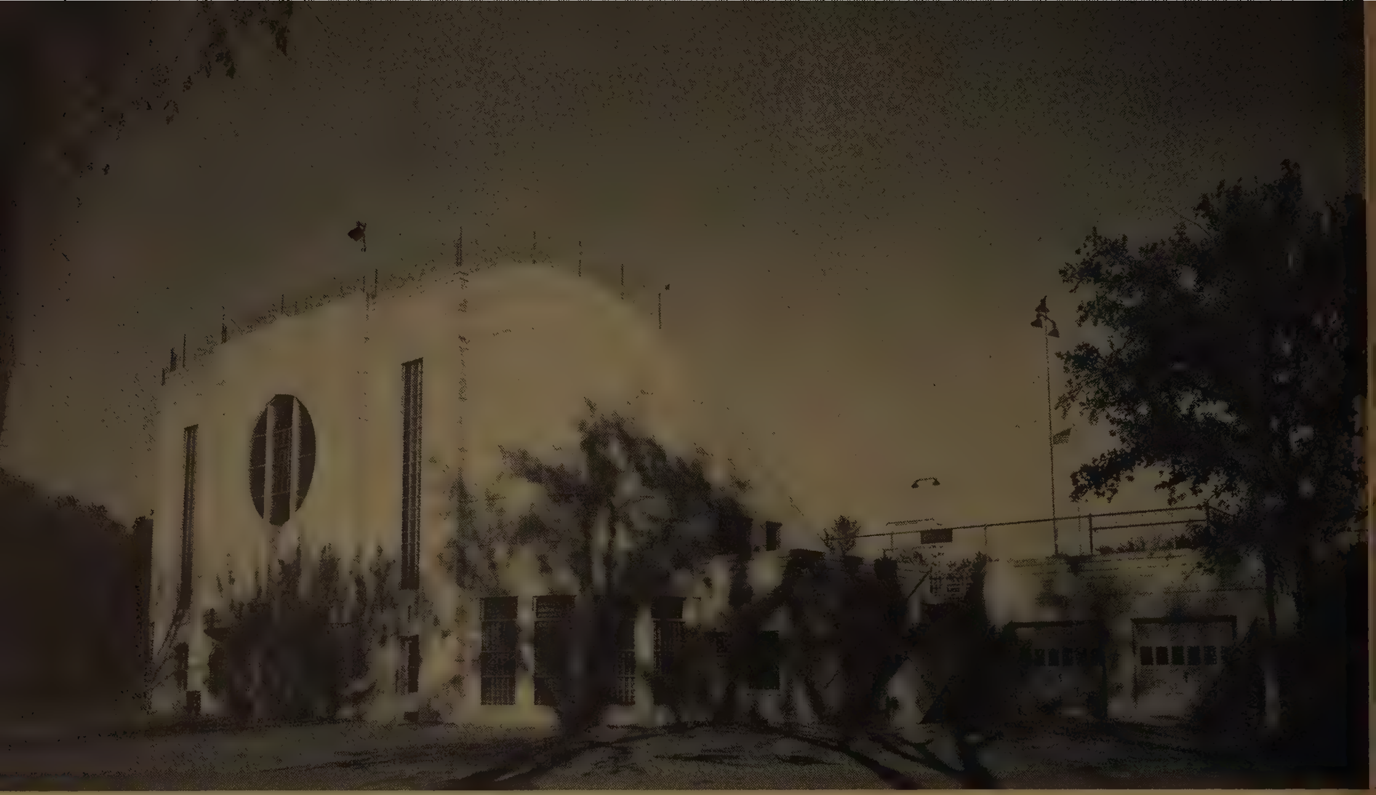
Minnesota State Agricultural Society
St. Paul, Minn.

KINDY C. WRIGHT and Associates, architects

The size and design of the building were established by
ree requirements; namely, the ring size had to be 120x240
, there had to be a fixed seat capacity of 8,800, with the
ssibility of an increase to 17,000 by temporary seats, and
ere could be no columns in the arena area. Study showed
at only two types of construction were feasible for the
ear span of 274 ft. necessary to meet the job requirements.
nce past experience had shown that concrete required
e minimum maintenance expense, a most important con-
deration for Fair buildings, reinforced concrete construc-
n was decided upon. Ready availability of materials was
so a factor in the choice. As designed, the building will
ave architectural concrete walls and the roof will be of
D construction. Roberts and Schaefer Co., engineers of
hicago, was retained to design the roof and structural frame. The building will be 240x421 ft. in plan and 88 ft. high.

The 12 arch ribs of the roof vary from 1 ft. 10 in. wide at the crown to 2 ft. 6 in. at the spring line, and from 6 ft. 3 in. to 15 ft. 6 in. deep. The ribs at 34-ft. centers support and stiffen the reinforced concrete roof shell, which varies from 4½ in. thick at the ribs to 3½ in. midway between them. The ribs are to be on the outside to provide a smooth ceiling for architectural effect and to facilitate use of moving forms. A feeling of strength and ruggedness is given to the exterior by the projecting ribs.

When completed in time for the 1948 Exposition, the structure will be one of the largest and finest of its kind in the nation. It will be a structure of which the State Fair and the people of Minnesota may well be proud.



Highly popular municipal swim stadium of Fargo, N. D., Braseth and Houkom, architects. Entrance to pool dressing room is at center of stadium beneath large circular window.

Swim Stadium —Fargo, N. D.

By S. M. Houkom, Architect*

During the summer months one of the more popular places in Fargo, N. D., is the municipal swimming pool in the city park. Often host to more than a thousand swimming enthusiasts at a time, the pool has a capacity of close to 1,400 and its grandstand will accommodate 800. It is the annual scene of swimming meets and other aquatic events.

To build the stadium of architectural concrete was natural, since that was the material of the pool itself. Moreover, concrete was considered a necessity for any construction at this site because the soil underlying the surrounding area is not noted for its stability. Because of this factor, a much more careful preliminary study was made than would normally be required.

Trips were made to other pools in the surrounding territory. The experience of others on similar projects was carefully checked. And finally, a thorough study was made of the foundation conditions at the site. It was concluded that a reinforced concrete frame structure on continuous footings and with architectural concrete walls would best meet the conditions imposed by the site and the use to which the structure would be put.

The entire layout covers an area of 189x174 ft. The pool proper is 165x100 ft. and the grandstand occupies a space 78x50 ft. For reasons of sanitation and for control of entry into the pool, a steel wire fence 7 ft. high separates grandstand and pool. Underground and entirely surrounding the pool is a reinforced concrete pipe tunnel, measuring 4 ft. high and 3 ft. wide.

Designed for customer comfort during afternoon aquatic meets, the grandstand was placed on the west side of the pool so the sun would be at the onlooker's back. For the spectator's further convenience, the pool's twin diving platforms have been placed at right angles to the grandstand to provide the best view of the divers. Also, each row of seats rises sharply above the one below so as to give perfect observation from any point.

Under the bleacher's 17 rows of concrete seats are a 22x78-ft. community meeting room, and the shower and dressing rooms for men and women. Each of these is 38x48 ft. and contains the usual appointments for swimmers. Ample daylight illumination is provided for these rooms through the 10-ft. diameter flat glass window flanked by gh, narrow glass block panels in the upper part of the ll and through windows of more conventional size and ape nearer the ground level.

---

*Fargo, N.D.

Public rest rooms not accessible to swimmers are located each end of the stadium close to the stairways leading the bleachers. At the south end is the garage, housing hicles used in the adjacent park area. At the north end e the boiler and fuel rooms, and behind these rooms are filters and other water treatment equipment. The boiler ck is concealed in an ornamental concrete pillar that nds a little back from the pool's edge.

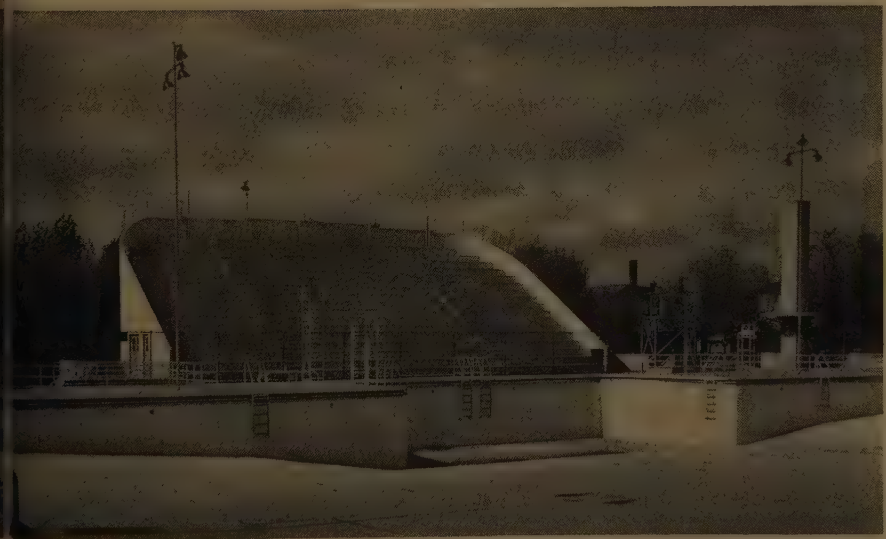
The pool varies in depth from 2 ft. 6 in. to 10 ft. The -ft. deep portion, 22x50 ft. in area, is directly in front the grandstand where the divers can display their skill. ost of the pool, however, is less than 6 ft. deep to provide nple safe swimming space.

Because of the low bearing value of the soil, continuous otings were made large to minimize the soil pressure and bridge over any especially bad places. These footings were more heavily reinforced than normally. All walls of the grandstand and the pool are 12 in. thick and are provided with the standard reinforcement for such construction. Copper dams and steel dowels were used at all construction joints.

Washed sand and gravel were used as aggregates. The coarse aggregate was graded from 1½ in. down to pea size. The sands were deficient in fines, as is often the case, so some fine plasterer's sand was added.

A close check was maintained at all times on the water-cement ratio to assure 3,000-lb. concrete at 28 days. All concrete was transported in buggies and was hand placed and spaded. Wall forms were of plywood. They received the usual paraffin oil treatment to facilitate stripping, but care was exercised to be sure that an excess of oil was not left in the forms. This will cause dusting of the concrete surface. All exposed concrete walls were given a grout cleandown; otherwise they were left just as they came from the forms.

onomical use of space and grace- lines have combined to produce a ucture at once functional and ractive.



Pool side of stadium. Note diving platforms at right angles to grandstand section, sharply rising rows of seats, and fence separation of swimmers from spectators. Ornamental concrete column at pool's edge houses stack for boiler room below.

Industrial Plant in Mississippi

By James T. Canizaro*, AIA

When officials of the Armstrong Tire and Rubber Co. began preliminary surveys in connection with the construction of their new industrial plant at Natchez, Miss., they were concerned, as most owners are, not only with providing adequate buildings for the production processes involved but also with the cost of such buildings. A choice of reinforced concrete was made after considering all the factors involved since it promised them the most for their construction and maintenance dollar. The plant involves seven structures, all walls of which are architectural concrete with building frames of reinforced concrete. Thin concrete barrel shells roof the main factory building.

Looking now at the completed buildings and having the cost figures per square foot at hand, I can say that the promise was well fulfilled. Built in 1938-39, the main factory cost only $1.03 per sq.ft. The warehouse was slightly more, $1.06. The figure for the press tire factory was $2.60, and that of the other main buildings, such as the cafeteria and office building which have extensive facilities and were built in 1945, was $4.85.

The all-concrete construction and a complete sprinkler system have combined to give the company the lowest fire insurance rate for an industrial plant in the state of Mississippi. Up to the present time maintenance costs have been very low and it is expected that they will remain so.

Built with due allowance for light and air, the plant is a closely compacted unit insuring coordination among various operating divisions. Each building is of strictly functional design according to its particular needs. This has produced an individuality of design in each structure, but the use of a single structural material throughout has helped to tie the different elements into a harmonious whole.

The main factory is a single-story building with a usable floor space of 188,000 sq.ft., plus 10,000 sq.ft. of mezzanine space. For the roof, we used the barrel-shell type of construction with shell 3½ in. thick stiffened by diaphragms. Each of the six shells span 40 ft. Supporting columns are spaced longitudinally at 50-ft. centers. A traveling form was used in the construction of this roof.

In designing the warehouse it was necessary to provide a cool, dark atmosphere for storage of rubber. To do this windows were omitted in this space and adjustable ventilators were placed in the north and south walls to insure proper and regulated flow of air. Construction joints at the floor levels and vertical control joints at regular intervals divide the walls into uniform rectangles with a ventilator in the upper center of each rectangle.

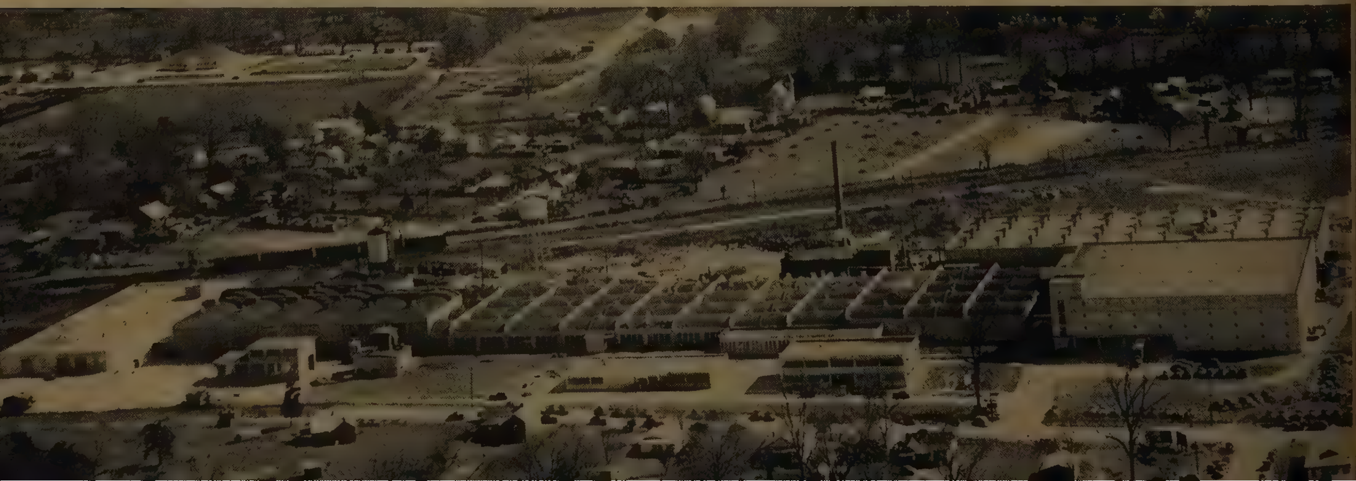
A large loading platform, with cantilevered concrete canopy, runs half the length of the warehouse. At one end of this, at the corner of the building, a setback tower extends one story above the roof of the warehouse. This houses the elevator hoist and stairway. Vertical window sash extending nearly four stories in height light the tower. Above this a large clock marks the highest point of any of the buildings.

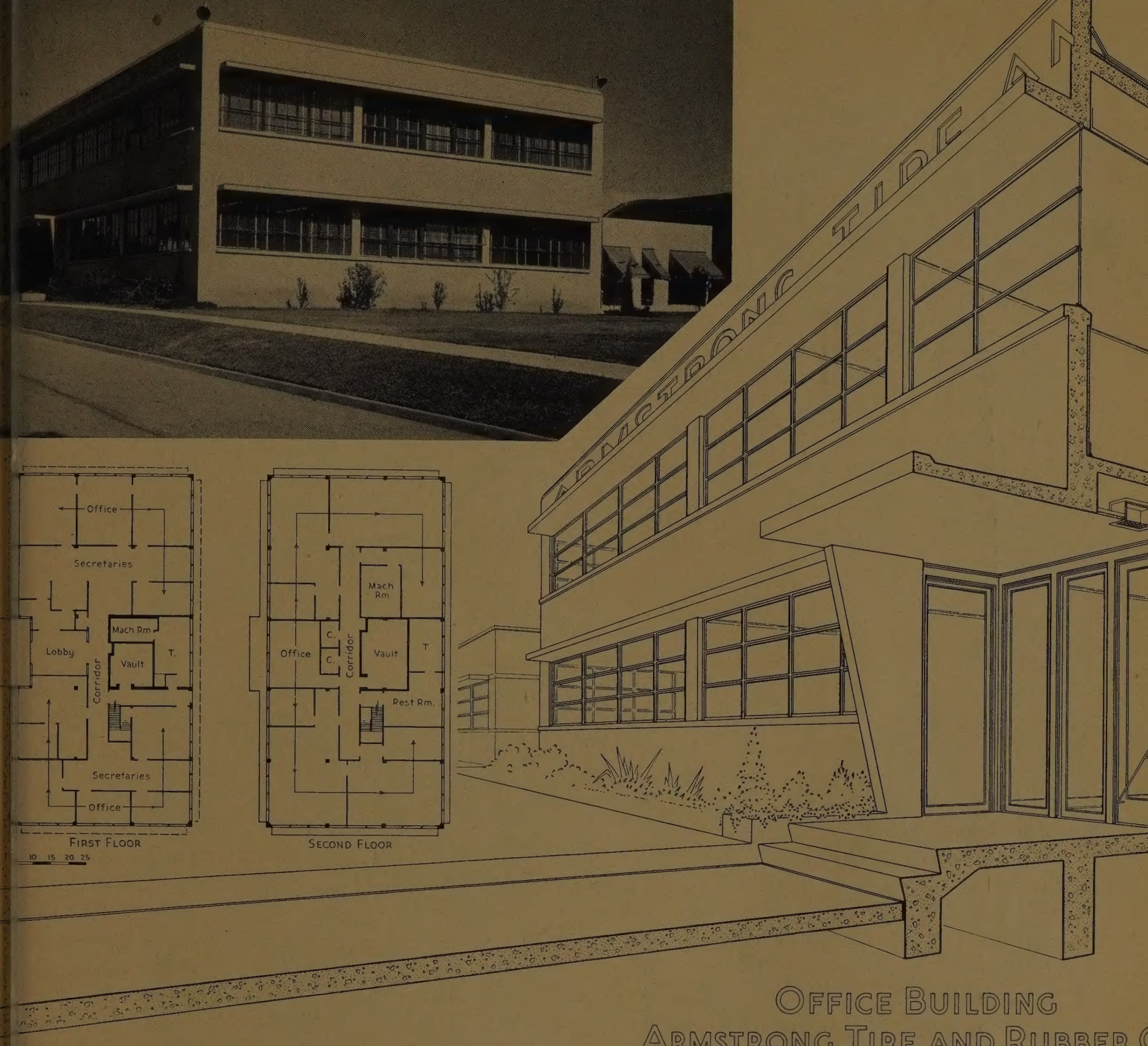
A feature of the company's main office and cafeteria buildings is the cantilevered canopies over all windows and

---

*Jackson, Miss.

Bird's-eye view of Armstrong Tire and Rubber Co. plant at Natchez, Miss., James T. Canizaro, architect-engineer of Jackson. Main factory building has barrel-shell roof. The raw storage building is at extreme left. The small two-story building to the right of this is the rubber cement building. The warehouse is at the extreme right with curing building back of it. The one-story cafeteria and two-story office building are in the center foreground.





OFFICE BUILDING
ARMSTRONG TIRE AND RUBBER

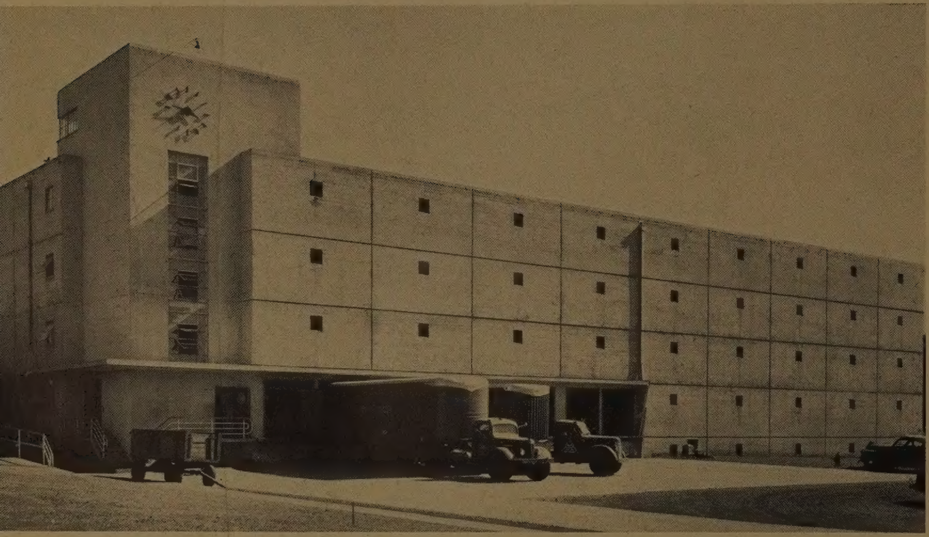
ors. These concrete “eyebrows” provide shade protection om the hot Mississippi sun in summer but permit the tter rays of the winter sun to enter and warm the interior. he normal 2-ft. extension over the windows is increased 5 ft. at the doorways. Triangular fins were added under e canopy at the entrance to the office building and give eater depth to the entry. A separate building is used incipally for making rubber cement, a highly volatile d explosive material. Here reinforced concrete provides cessary protection through its structural strength and e resistance. Windows in this building are so designed at they would readily blow out in case of an explosion d thus relieve any internal pressure against the walls.

Live loads used in the design varied from building to ilding, depending on occupancy. In the factory and rubber cement buildings, live load of 500 p.s.f. was used, while 300 p.s.f. was used in the warehouse and 100 p.s.f. in the office and cafeteria buildings. Design specifications provided for concrete having compressive strength of 3,000 p.s.i. in walls, beams and columns. In the floors on the ground, 2,500-lb. concrete was used.

Only the raw storage building is on a pile foundation. Here cast-in-place concrete piles were used because it was found when excavation started that the site was the location of an old pond.

In general, floors on the ground are 5-in. thick reinforced concrete slabs on 4-in. gravel fill with waterproof paper over the fill. In the raw storage building, 15-lb. saturated felt was used over the fill. The lobby of the office building has a terrazzo floor in four colors; brass strips

Like all buildings of the plant the one-story cafeteria is of simple design. Here, as in the office building, cantilevered concrete canopies shade the windows and doorway.



The warehouse is a four-story structure designed to provide cool, dark storage space. Ventilators are placed on opposite sides of the building and there are no windows in the storage space. The clock tower is a focal point for the entire plant.

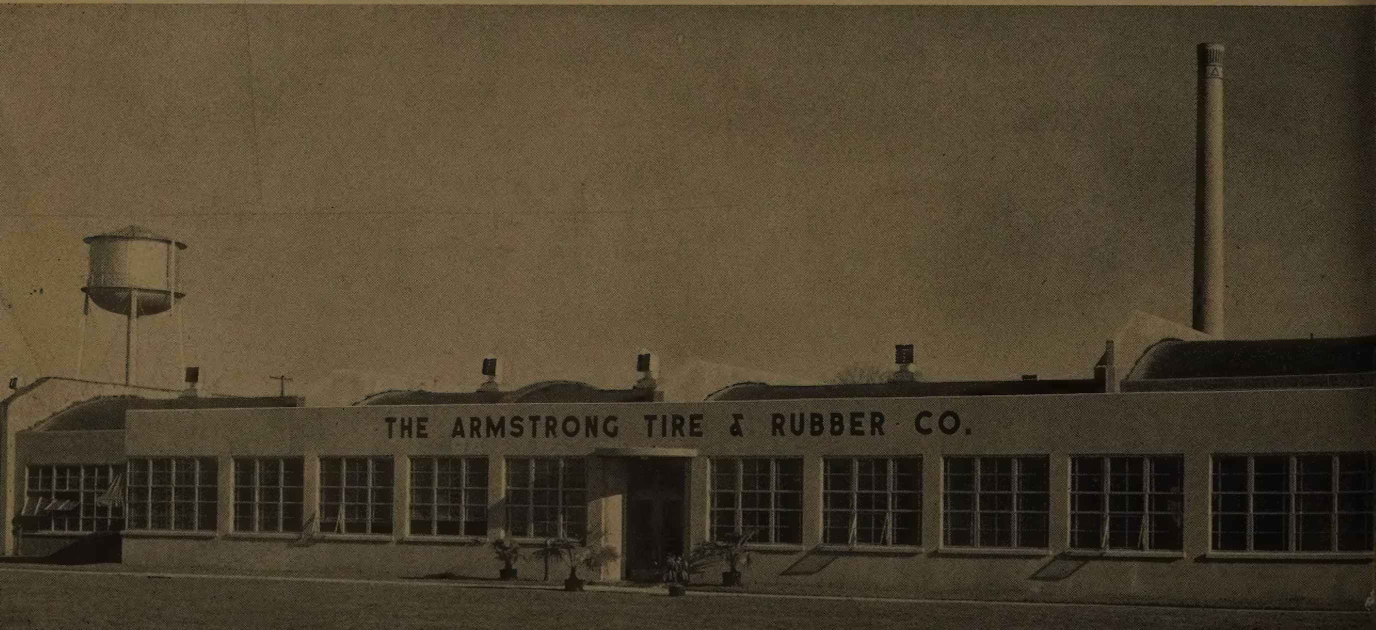
divide the surface into an attractive pattern. The roofs of all buildings are covered with 1 in. of insulation and a 5-year-guarantee builtup roofing which have proved to be all the insulation necessary to keep the buildings cool.

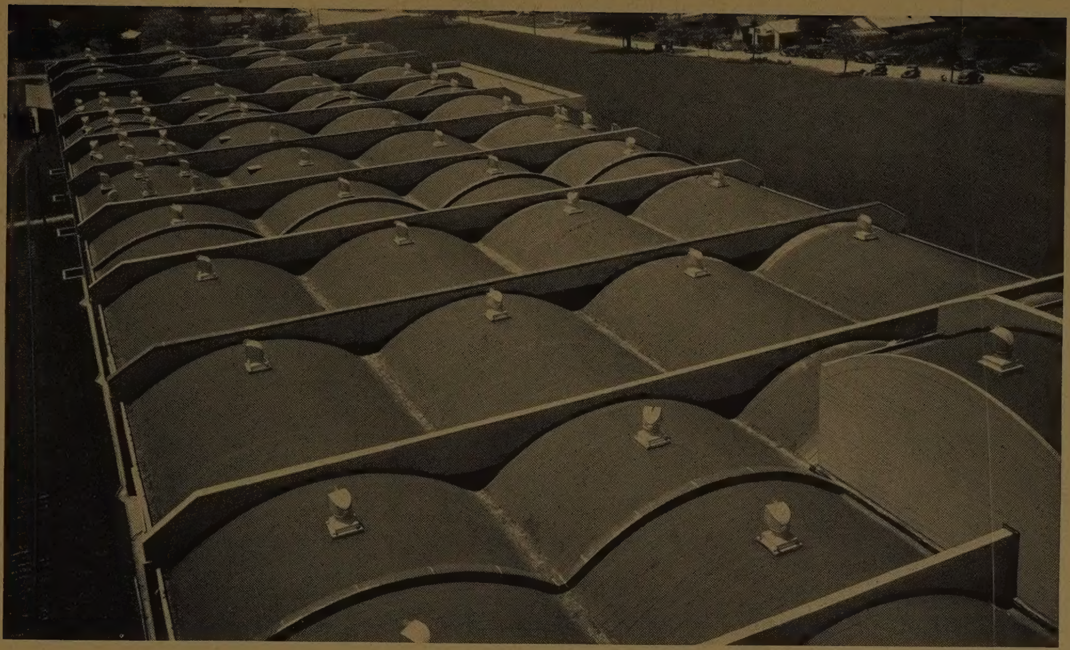
To construct the formwork both plywood and 1x6-in. boards were used for sheathing. Using the latter for the exposed walls of the warehouse and storage buildings resulted in an attractive board mark finish. Company officials are well pleased with this finish and have asked that it be used exclusively in all future plant expansion.

Column and beam spacing was so planned that form panels could be used as many times as possible. In some cases as high as 11 re-uses were found feasible. Sizes of members were established to permit using stock-size lumber, and this greatly reduced the amount of cutting and allowed more re-uses. Beam depths were kept uniform as much as possible so that shores of the same height could be used throughout a building. This made for considerable economy.

Vertical control joints were used in all buildings at regularly spaced intervals. In some cases, as on the warehouse, they were used deliberately to create a rectangular pattern with the horizontal construction joints, but on other buildings they are very inconspicuous. Contraction has, as of this

The small office building constructed at the same time as the main factory is now used as the engineering department.



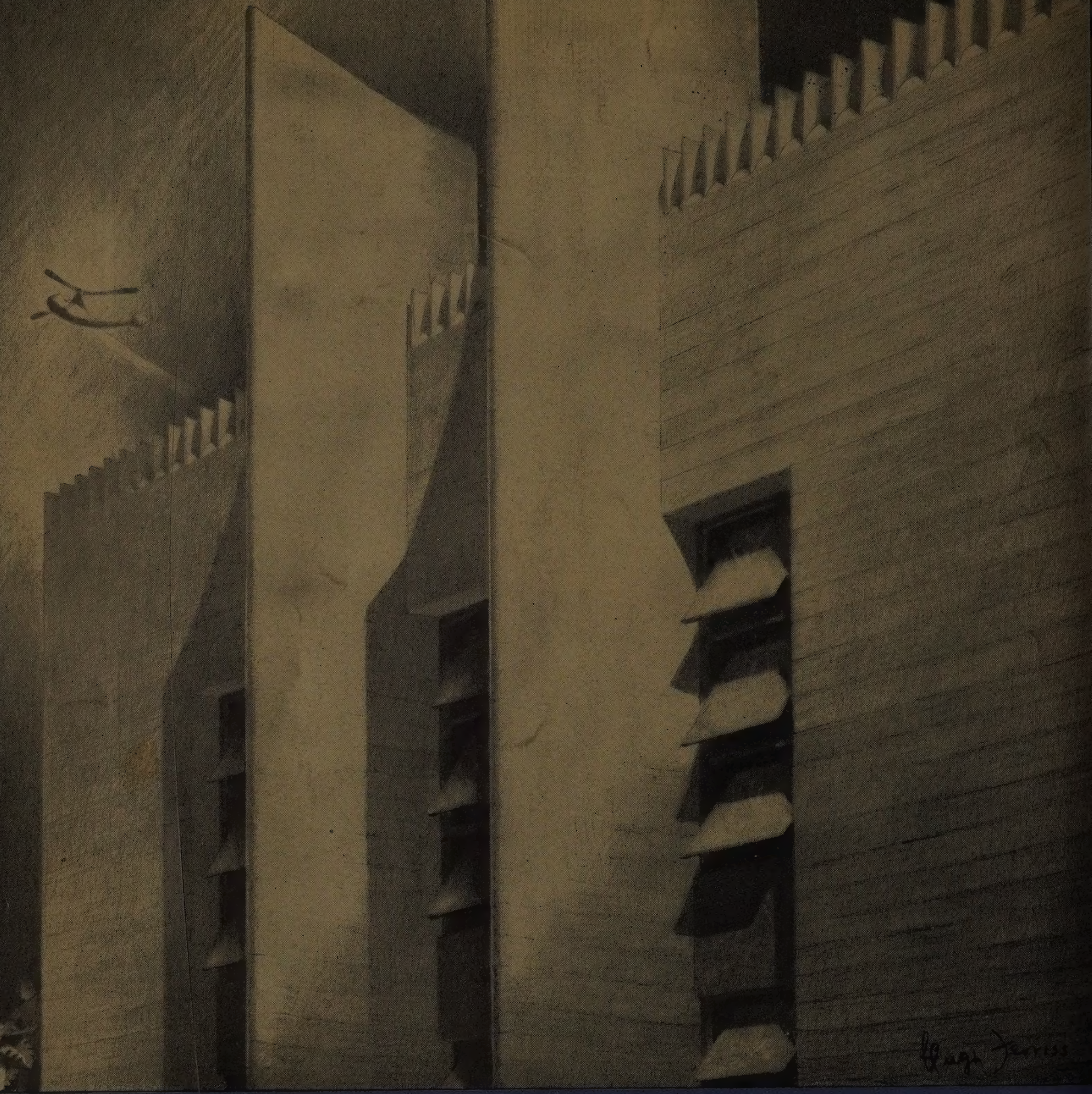


he roof of the
ain factory
ilding is a
ies of concrete
rrel shells $3\frac{1}{2}$
. thick. Each
ans 40 ft. with
aphragm stif-
ners at 50-ft.
ervals longi-
linally.

nstruction
w inside fac-
y building.
aveling forms
re used to con-
uct roof bar-
's. Design
es bays 40x50
between col-
ns.

te, produced no cracking except in the control joints.
The writer has served as architect for the entire project
l as engineer for all except the main factory building,
which Roberts and Schaefer Co. of Chicago was engi-
er, and the warehouse, for which H. N. Howe of Memphis
de the engineering design. B. L. Knost, Pass Christian,
ss., was contractor on the main factory building. Harmon
nstruction Co. of Oklahoma City was the contractor on
press tire factory and Hillyer and Lovan of Jackson-
e, Fla., were contractors on all the other structures.

Wide column spacing makes possible twin production lines in each bay. Monorail conveyor and other fixtures are suspended from barrel roof.



ARCHITECTURAL CONCRETE

In Architectural Concrete, features such as the bladed pylons and crown molding illustrated here by Hugh Ferriss, may be cast in one operation as integral parts of the whole structure. This is typical of the economies effected by using concrete for apartment houses, hotels, hospitals, schools or industrial buildings.

PORTLAND CEMENT ASSOCIATION
33 WEST GRAND AVENUE CHICAGO 10, ILLINOIS

A national organization to improve and extend the uses of concrete . . . through scientific research and engineering field work